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## Reconceiving Resilience: A New Guiding Principle for Financial Regulation?

**Mary Dowell-Jones\* & Ross Buckley\*\***

*Abstract: Most postcrisis financial regulation is expressed to be in the pursuit of increasing the resilience of the global financial system. “Resilience” features in the formal title of the Basel III reforms to bank capital adequacy rules. This article explores the meaning of resilience from social-ecological systems science and applies it to international finance. We conclude that postcrisis financial regulation has in fact sought to build a stronger, more robust system, not a more resilient one. The regulation imposed on global systemically important financial institutions is designed to make these institutions too strong to fail, not give them the capacity to reorganize themselves, or transition to a new equilibrium, in the face of major external shocks. This article challenges the fundamental thinking behind seven years of postcrisis financial regulation and suggests we need far more rigorous research into what a truly resilient international financial system would look like and how it would be regulated.*

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## I. INTRODUCTION

Resilience is broadly defined as “the capacity of a system to avoid disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks.”<sup>1</sup> It is a concept with a multidisciplinary pedigree with roots in ecology, security analysis and childhood trauma, among others, and which focuses on the dynamic capacity of a complex, adaptive, nonlinear system to self-repair in response to stress or to transition to a new stable equilibrium, rather than the capacity of a system to function without succumbing to crisis in the first place. It is therefore a useful concept to apply to finance because of the tendency of the globally integrated financial system to swing from one crisis to another,<sup>2</sup> and it is a term that has come to feature heavily in postcrisis debates about financial stability.<sup>3</sup> In light of the scale of the global financial crisis of 2008 and the bailouts required to save the system, resilience is seen as a highly desirable attribute of today’s integrated global markets and an objective of postcrisis regulatory reforms.

However, as a broad, multidisciplinary concept, it is not unproblematic in its application to finance because it does not immediately offer a practical, concrete agenda for reform specific to the financial markets. *Resilience*, as it is applied in disciplines like ecology, for example, is generally a descriptive rather than normative attribute of a system, i.e. undesirable systems can be characterized as resilient because they also have the capacity to endure in the face of shocks. To understand resilience, the key structural attributes of a

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<sup>1</sup> Brian H. Walker, C. S. Holling, Stephen R. Carpenter & Ann Kinzig, *Resilience, Adaptability and Transformability in Social-Ecological Systems*, 9(2) ECOL. SOC. 5 (2004).

<sup>2</sup> When the crises that have been produced by the financial markets over the last quarter of a century are listed, it is immediately striking that the periods without crises are by far the rarer creature: Eurozone crisis (2010–); Global Financial Crisis (2007–2009); Global Food & Fuel Crisis (2005–2008) (although this is not counted as a financial market crisis proper, it resulted from the global asset boom & increased trading in agricultural commodities, and it had a very serious impact on the world’s poorest people); Dotcom Crisis/Argentina (2001–2003); Russia/Latin America (1998–1999); LTCM (1998); Asian Financial Crisis (1997–1998); Bond Market Crisis (1994); European ERM Crisis (1992–1993); Stock Market Crash (1987). CHARLES P. KINDLEBERGER & ROBERT Z. ALIBER, *MANIAS, PANICS AND CRASHES: A HISTORY OF FINANCIAL CRISES* (6<sup>th</sup> ed. 2011); CARMEN M. REINHART & KENNETH S. ROGOFF, *THIS TIME IS DIFFERENT: EIGHT CENTURIES OF FINANCIAL FOLLY* (2009); ROSS P. BUCKLEY & DOUGLAS W. ARNER, *FROM CRISIS TO CRISIS: THE GLOBAL FINANCIAL SYSTEM AND REGULATORY FAILURE* (2011).

<sup>3</sup> See, e.g., BASEL COMM. ON BANKING SUPERVISION, BANK FOR INT’L SETTLEMENTS, CONSULTATIVE DOCUMENT: STRENGTHENING THE RESILIENCE OF THE BANKING SECTOR (2009); BANK OF ENG., FINANCIAL STABILITY REPORT: BUILDING A MORE RESILIENT FINANCIAL SYSTEM 36–57 (JUNE 2009); FIN. STABILITY FORUM, REPORT OF THE FINANCIAL STABILITY FORUM ON ENHANCING MARKET AND INSTITUTIONAL RESILIENCE (Apr., 2008); Mario Draghi, President, European Cent. Bank, Speech at the 2013 International Monetary Conference: Strengthening Financial Resilience (June 3, 2013), <http://www.ecb.europa.eu/press/key/date/2013/html/sp130603.en.html>.

system and its essential dynamics, interdependencies and feedback loops need to be mapped. However, the complexity and lack of transparency of today's global financial markets make this exceptionally difficult. Where the term *resilience* is used in regulatory debates, it often indicates a generally desired condition of systemic stability which is assumed to flow from the proposed regulatory measures. It is not generally used to denote a particular approach to understanding the dynamics of global finance and the required management/regulatory responses for achieving stability. Thus, resilience is used in a generic, descriptive manner rather than as the organizing goal of a new regulatory approach. While there is wide-ranging stakeholder agreement on the value of increased financial system resilience, *resilience* does not in and of itself offer an immediate agenda for reform, and despite the frequent use of the term in regulatory debate, no one really knows whether the postcrisis regulatory changes will have this effect.

Our purpose is to review certain key characteristics of resilience as it has been applied in social-ecological systems science (SES) where the concept first emerged, and to analyze whether they offer insights into the better management of financial systems, particularly the global financial system. Applying SES resilience thinking to finance raises acute questions around our understanding of financial systems as systems, and their key dynamics, risk factors and stability determinants; and raises the fundamental issue of whether we understand the financial system sufficiently well to even be able to develop a regulatory agenda for resilience.

## II. RECOGNIZING RESILIENCE – WILL WE KNOW IT WHEN WE SEE IT?

One of the problems with applying the concept of resilience to the international financial system is that it is not clear that we will know it when we see it. Nor is it self-evident that the concept provides a specific roadmap for change. Resilience has become a “pervasive idiom of global governance”<sup>4</sup> that:

has in the recent past rapidly infiltrated vast areas of the social sciences, becoming a regular, if under-theorized, term of art in discussions of international finance and economic policy, corporate risk analysis, the psychology of trauma, development policy, urban planning, public health and national security.<sup>5</sup>

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<sup>4</sup> Jeremy Walker & Melinda Cooper, *Genealogies of Resilience: From Systems Ecology to the Political Economy of Crisis Adaptation*, 42(2) SECURITY DIALOGUE 143, 143 (2011).

<sup>5</sup> *Id.*

As should be expected of a concept that can be applied so broadly across disciplines, its inherent malleability fosters its multidisciplinary uptake, but the challenges in reconfiguring the international financial architecture mean it can only provide broad principles of thought.

Perhaps the biggest problem with the concept of resilience is that it can easily be mistaken for something else. Most commonly, it has been mistaken for interludes of market calm between crises. It is also called in aid to justify the apparent success of new financial products, ideas and reforms, before they have had time to cause harm.

In 2005, the Director of the IMF's International Capital Markets Department stated that "For four straight years the global financial system has shown impressive resilience."<sup>6</sup>

In 2005, Alan Greenspan remarked that "[t]he use of a growing array of derivatives and the related application of more-sophisticated approaches to measuring and managing risk are key factors underpinning the greater resilience of our largest financial institutions . . . ."<sup>7</sup>

In 2006, the IMF asserted that "the dispersion of credit risk by banks to a broader and more diverse group of investors, rather than warehousing such risk on their balance sheets, has helped to make the banking and overall financial system more resilient."<sup>8</sup>

In August 2007, the Governor of the Bank of England, Mervyn King stated:

[I]t is very important to set a very, very key point here, which is that our banking system is much more resilient than in the past. Precisely because many of these risks are no longer on their balance sheets but have been sold off to people willing and probably more able to bear it.<sup>9</sup>

One month later, the Bank of England was dealing with the first run on a British bank in over one hundred years.<sup>10</sup>

Despite these errors in recognizing resilience, the idea of resilience has

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<sup>6</sup> Gerd Häusler, *Why the Global Financial System is More Resilient*, INT'L MONETARY FUND: VIEWS & COMMENTARIES (Oct. 7, 2005), <http://www.imf.org/external/np/vc/2005/100705e.htm>.

<sup>7</sup> Alan Greenspan, Chairman, Bd. of Governors of the Fed. Reserve Sys., Remarks delivered to the Federal Reserve Bank of Chicago Conference on Bank Structure: Risk Transfer and Financial Stability (May 5, 2005), <http://www.federalreserve.gov/Boarddocs/Speeches/2005/20050505>.

<sup>8</sup> IMF, *Market Developments and Issues*, Global Financial Stability Report, at 51 (Apr. 2006).

<sup>9</sup> Bank of Eng., *Inflation Report Press Conference* (Aug. 8, 2007), <http://www.bankofengland.co.uk/publications/Documents/inflationreport/conf080807.pdf>.

<sup>10</sup> Although there had been bank collapses such as Barings in 1995, a run on the retail deposits of a British bank had not occurred since Victorian times. In 1866, a run on deposits was triggered by the collapse of Overend, Gurney & Co., and in 1878 by the collapse of the City of Glasgow Bank. TREASURY COMMITTEE, THE RUN ON THE ROCK, 2007-8, HC 56-I, at 8-9 (UK).

become ubiquitous in regulatory debates. As the Bank of England remarked in its 2009 Financial Stability Report chapter titled “Building a more resilient financial system”:

The financial system should be capable of absorbing shocks from the economy and from financial markets rather than generating them. It also needs to be much better able to support economic activity on a sustainable basis, without relying on large-scale publicly funded support to weather shocks. This will require fundamental changes to the way the financial sector is regulated, supervised and manages its own affairs.<sup>11</sup>

The Basel III international capital adequacy regulations which emerged out of the crisis are formally titled “A Global Regulatory Framework for More Resilient Banks and Banking Systems,” and their overarching objective is “to improve the banking sector’s ability to absorb shocks arising from financial and economic stress, whatever the source, thus reducing the risk of spillover from the financial sector to the real economy.”<sup>12</sup> This conceives of resilience of the financial system as separate and distinct from the resilience of the broader economy or society, as if the one can be defined in isolation from the other. The fact that regulators in various jurisdictions have chosen to adopt higher capital requirements than those mandated in these regulations indicates in any case less than full consensus on the framework’s ability to achieve the desired financial stability and resilience outcomes.<sup>13</sup> The Basel III framework establishes a soft law set of minimum standards for the global banking system, with national regulators free to go beyond the minimum. In practice, “most jurisdictions have adopted minimum requirements that exceed the global standard,” which has been labelled as “super-equivalence.”<sup>14</sup>

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<sup>11</sup> BANK OF ENG., *supra* note 3, at 36.

<sup>12</sup> BASEL COMM. ON BANKING SUPERVISION, BANK FOR INT’L SETTLEMENTS, *BASEL III: A GLOBAL REGULATORY FRAMEWORK FOR MORE RESILIENT BANKS AND BANKING SYSTEMS* 1 (2011), <http://www.bis.org/publ/bcbs189.pdf>.

<sup>13</sup> See IMF, *Australia: Addressing Systemic Risk Through Higher Loss Absorbency — Technical Note*, at 10 tbl. 4, Country Report No. 12/311 (Nov. 2012); KPMG, *Basel 4 – Emerging from the Mist?*, KPMG: INSIGHTS (Sep. 4, 2013), <https://home.kpmg.com/content/dam/kpmg/pdf/2013/09/emerging-from-the-mist.pdf>; ANAD ADMATI & MARTIN HELLWIG, *THE BANKERS’ NEW CLOTHES: WHAT’S WRONG WITH BANKING AND WHAT TO DO ABOUT IT* (2013); Ross P. Buckley, Rolf H. Weber & Mary Dowell-Jones, *A Swiss Finish for Australia? Approaches to Enhancing the Resilience of Systemically Important Banks*, 10(1) CAP. MKT. L.J. 41 (2015).

<sup>14</sup> Stefan Ingves, Chairman, Basel Comm. on Banking Supervision, Governor, Sveriges Riksbank, Keynote Speech at the Meeting for the Americas, Lima, Peru: *Basel III Implementation: Progress, Pitfalls and Prospects* (Nov. 5, 2014), <http://www.bis.org/speeches/sp141105.htm>; see also BASEL COMM. ON BANKING SUPERVISION, BANK FOR INT’L SETTLEMENTS, *IMPLEMENTATION OF BASEL STANDARDS: A REPORT TO G20 LEADERS ON IMPLEMENTATION OF THE BASEL III REGULATORY REFORMS* (Nov. 2014),

The Financial Stability Forum, precursor to the Financial Stability Board, also adopted a resilience framework for its reform agenda, without specifying how it defined resilience or what a resilient financial system should look like. The schedule of measures that it proposed responded to the particular failures identified during the crisis, rather than setting out a new vision for the financial system. The stated goal was “to strengthen the efficiency and resilience of the system, without hindering the processes of market discipline and innovation that are essential to the financial system’s contribution to economic growth.”<sup>15</sup> Notwithstanding that recent “innovation” had caused systemic meltdown, this implied that the system and the ideas on which it was built were fundamentally sound, but that action was needed on the specific failures that led to the crisis. This is an approach which has been continued by its successor the Financial Stability Board. In his letter to the G20 summit in Brisbane, Mark Carney, the Chair of the Financial Stability Board, declared, “Strengthened international standards are building more resilient financial institutions and more robust markets.” He noted that the G20 had “worked intensively . . . to correct the fault lines that led to the global financial crisis.”<sup>16</sup>

Another example of the postcrisis use of *resilience* in financial regulatory debates is provided by a speech in 2011 by González-Páramo, member of the Executive Board of the European Central Bank.<sup>17</sup> The speech uses *resilience* or *resilient* twelve times, and yet fails to provide any indication of what is meant by a resilient financial system. It is assumed that this is an objective that requires no further explanation. González-Páramo states “Why is the resilience of the financial system so important? The financial system is the lifeblood of the real economy. It touches all facets of our economy from households to corporations and even governments.” He then focuses on the need for “a resilient risk management framework for the future” resting on “the twin pillars of statistical risk models and stress testing,” even though this is precisely the architecture of risk management

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<http://www.bis.org/bcbs/publ/d299.pdf>.

<sup>15</sup> FIN. STABILITY FORUM, REPORT OF THE FINANCIAL STABILITY FORUM ON ENHANCING MARKET AND INSTITUTIONAL RESILIENCE, 2 (Apr. 2008), [http://www.fsb.org/wp-content/uploads/r\\_0804.pdf?page\\_moved=1](http://www.fsb.org/wp-content/uploads/r_0804.pdf?page_moved=1).

<sup>16</sup> Letter from Mark Carney, Chair, Financial Stability Board, Governor, Bank of Eng., to G20 Leaders 1, 5 (Nov. 7, 2014), <http://www.fsb.org/wp-content/uploads/FSB-Chair's-Letter-to-G20-Leaders-on-Financial-Reforms-Completing-the-Job-and-Looking-Ahead.pdf>; See also *Building Resilient Financial Institutions*, FINANCIAL STABILITY BOARD, [www.financialstabilityboard.org/what-we-do/policy-development/building-resilience-of-financial-institutions](http://www.financialstabilityboard.org/what-we-do/policy-development/building-resilience-of-financial-institutions).

<sup>17</sup> José Manuel González-Páramo, Member, Executive Board of the European Central Bank, Speech delivered at the 3<sup>rd</sup> Annual Risk and Return Russia Conference: Risk, Return, Resilience: The Future Financial System (Apr. 14, 2011), <http://www.ecb.europa.eu/press/key/date/2011/html/sp110414.en.html>.



which failed so spectacularly in the run up to and during the crisis.

*Resilience*, then, appears to be generally used as a broad descriptive term for the goal of measures which regulators have decided upon, rather than a new paradigm for financial stability from which to build. As one commentator has noted, “current efforts to rebuild and reshape the financial system fail to engage in depth the necessary preliminary questions about what resilience might mean and who should be the subject of resilience-building measures.”<sup>18</sup> They are heavily, if not exclusively, focused on the resilience of the financial system alone, as if that can be defined in isolation from the way the financial system interacts with broader economic and socio-political institutions. If financiers and regulators with decades of experience in the international financial and monetary system cannot correctly identify market resilience, and instead mistake precrisis symptoms for it, even as these are reaching a critical stage, how useful is the concept as a broad policy tool? Does the notion of resilience inject a new dynamic in the regulatory endeavor, or is it merely a generic term for financial stability?

### III. UNDERSTANDING THE CONCEPT OF RESILIENCE

As a starting point, it is increasingly recognized that the financial system is a complex, nonlinear system<sup>19</sup> like the social-ecological system, and is therefore akin to a “financial ecosystem.”<sup>20</sup> One of the key issues in defining an agenda for a resilient financial system is to understand the nature, structure, and key characteristics of the financial *system*. Given the scale, complexity and rapid growth of financial markets, this is not self-evident, as the system has fundamentally changed over the last two decades. During the crisis it became apparent that regulators and financial institutions had simply failed to understand the changes that had taken place in the financial system over the years leading up to the crisis, and did not recognize transmission mechanisms and interconnections between firms and markets and between the financial system as a whole and the broader economy.<sup>21</sup> Without a deep

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<sup>18</sup> Joanna Gray, *Toward a More Resilient Financial System?*, 36 SEATTLE U. L. REV. 799, 802 (2013).

<sup>19</sup> See, e.g., Andrew G. Haldane, Executive Director of Financial Stability, Bank of England, Speech delivered at the Financial Student Association, Amsterdam: Rethinking the Financial Network (Apr. 28, 2009), <http://www.bis.org/review/r090505e.pdf>; John Kambhu, Scott Weidman & Neel Krishnan, *New Directions for Understanding Systemic Risk: A Report on a Conference Cosponsored by the Federal Reserve Bank of New York and the National Academy of Sciences*, 13(2) NYFR ECON. POL. REV. 83 (2007).

<sup>20</sup> See generally Andrew G. Haldane & Robert M. May, *Systemic Risk in Banking Ecosystems*, 469 NATURE 351 (2011); Robert M. May, Simon A. Levin & George Sugihara, *Ecology for Bankers*, 451 NATURE 893, 893–95 (2008).

<sup>21</sup> FIN. CRISIS INQUIRY COMM’N, THE FINANCIAL CRISIS INQUIRY REPORT: FINAL REPORT OF THE NATIONAL COMMISSION ON THE CAUSES OF THE FINANCIAL AND ECONOMIC CRISIS IN THE UNITED

understanding of the nature of the system and the way it evolves in relation with other interlocking systems such as economic, political, social and ecological systems, it is impossible to determine an agenda for building financial resilience.<sup>22</sup> Analyzing the dynamics of resilience in the social-ecological domain and applying them within the context of financial markets should enable the construction of an agenda for building resilience in financial systems.

#### A. Resilience as a paradigm shift

Resilience theory emerged in ecology debates during the 1970s as an attempt to analyze the capacity of ecological systems to resist disturbance in the face of shocks.<sup>23</sup> It drew on complex adaptive systems theory and second-order quantum cybernetics to move thinking away from the model of classical equilibrium that had until then predominated in scientific thinking. The classic model had focused on the idea of a “balance of nature” or a steady, stable state in ecology which did not accommodate the reality of constant, dynamic, and random change within a system which permitted adaptive responses to disturbance.<sup>24</sup> The shift in thinking was largely a response to scientific approaches to natural resource management that had focused on quantitative metrics of producing the maximum yield from an ecosystem, based on the idea of a simple, steady state equilibrium to which a natural system would tend to revert after a shock. This approach had downplayed and underestimated the importance of complex networks of interdependencies within the system and was argued to be fundamentally destabilizing to an ecosystem.<sup>25</sup> The emphasis of this management approach on stressing the ecosystem to produce the maximum yield weakened the system by reducing the fundamental diversity which supports its capacity to absorb shocks. Because this approach fundamentally misunderstood the complex, adaptive nature of an ecosystem and the function of diversity, and assumed linear, stable relationships between various aspects of the system, it led to monocropping, overexploitation, and the loss of the diversity essential

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STATES (2011).

<sup>22</sup> May, Levin & Sugihara, *supra* note 20, at 894 (“[T]he dynamical implications of the topology of financial networks emerge as good candidates for further research.”); *see also* Haldane & May, *supra* note 20.

<sup>23</sup> *See* C. S. Holling, *Resilience and Stability of Ecological Systems*, 4 ANN. REV. OF ECOLOGY & SYSTEMATICS 1 (1973), which was a seminal paper in this regard.

<sup>24</sup> JOHN KIRCHNER, *THE BALANCE OF NATURE: ECOLOGY’S ENDURING MYTH* (2009).

<sup>25</sup> Walker & Cooper, *supra* note 4, at 146 (“[T]he long-term expectation of stability may be inherently destabilizing. When managed with the expectation of a permanent and fixed yield, the complex interconnections supporting the resilience of the ecosystem as a whole may become undetectably fragile, undermining its productivity.”).

to system survival.<sup>26</sup>

One example of the damage done by this approach is provided by scientific forestry. To maximize the return on commercial forestry, a new “science” of forest management emerged in Germany during the nineteenth century. In place of the old, messy, mixed forests, German state planners envisaged and planted uniform rows of single-species forests so as to produce the maximum useable commercial timber harvest.<sup>27</sup> Every aspect of the forest was assessed to gauge its economic, utilitarian value, which led to many subtle processes and flora being discounted as worthless.<sup>28</sup> While the first crop was a huge success which produced vastly more timber than the old forests, returns declined steeply thereafter because the scientific plan to simplify the forest and produce a maximum yield had failed to understand the dynamic importance of the diversity of the old forest to systemic resilience.<sup>29</sup>

A new word, *Waldsterben* (meaning “forest death”) even entered the German language to describe the results of such forestry monocrops, which starkly demonstrated “the dangers of dismembering an exceptionally complex and poorly understood set of relations and processes in order to isolate a single element of instrumental value.”<sup>30</sup>

This experience parallels the more recent one of credit derivatives and the housing market and illustrates the relevance of ecological resilience ideas for the financial ecosystem. In order to securitize thousands of home loans into structured products, the complex dynamic of relationships, both financial and personal, that comprise a housing market were reduced to a simple concept of “credit risk.”<sup>31</sup> This was itself simplified by using a proxy

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<sup>26</sup> Holling, *supra* note 23, at 21 (The very approach . . . that assures a stable maximum sustained yield of a renewable resource might so change these deterministic conditions that the resilience is lost or reduced so that a chance and rare event that previously could be absorbed can trigger a sudden dramatic change and loss of structural integrity of the system.).

<sup>27</sup> JAMES C. SCOTT, *SEEING LIKE A STATE: HOW CERTAIN SCHEMES TO IMPROVE THE HUMAN CONDITION HAVE FAILED* 15 (1998).

<sup>28</sup> *Id.*

<sup>29</sup> *Id.* at 20 (“An exceptionally complex process involving soil building, nutrient uptake, and symbiotic relations among fungi, insects, mammals, and flora – which were, and still are, not entirely understood – was apparently disrupted, with serious consequences. Most of these consequences can be traced to the radical simplicity of the scientific forest.”); *see also* Holling, *supra* note 23, at 11–22 for a description of scientific forestry.

<sup>30</sup> Holling, *supra* note 23, at 21.

<sup>31</sup> Stan J. Liebowitz, *Anatomy of a Train Wreck: Causes of the Mortgage Market Meltdown*, in *HOUSING AMERICA: BUILDING OUT OF A CRISIS* (B. Powell & R. Halcomb eds., 2009); *see also* David Greenlaw et al., *LEVERAGED LOSSES: LESSONS FROM THE MORTGAGE MARKET MELTDOWN*, PROCEEDINGS OF THE US MONETARY POLICY FORUM 2008, THE UNIVERSITY OF CHICAGO BOOTH SCHOOL OF BUSINESS, 2008; *see* SCOTT, *supra* note 27, at 103–46 for an analysis of the social complexity of residential space; RICHARD SENNETT, *THE CONSCIENCE OF THE EYE: THE DESIGN AND SOCIAL LIFE OF CITIES* (1990).

(life insurance survivorship rates) to create a homogenized product: Residential Mortgage Backed Securities (RMBS).<sup>32</sup> These could then be widely commercialized so as to produce the maximum financial yield from the underlying resource. Once the availability of RMBSs collided with conducive conditions in the international financial markets, it led to financial monocropping. In doing so, the complex, “scientific” mathematics of credit risk modelling and credit derivatives massively oversimplified and misunderstood the diverse range of relationships that drive a nation’s demand for housing credit and the complex interdependencies that ensure its resilience, by focusing on mortgage repayment probabilities and correlated default rates, assessed through statistical abstractions and historical data. As the head of asset-backed finance at Moody’s told a New York Times interviewer: “We aren’t loan officers . . . our expertise is as statisticians on an aggregate basis.”<sup>33</sup> Finance became blind to the subtle network of systems and social processes of which it was only one part and on which it depended.

Underlying the apparent success of credit derivatives and the risk transference they enabled in the short run, processes were set in motion by the application of this financial monocropping culture which restructured the subtle dynamics of the system and ignored those aspects which were of no commercial value, or difficult to program into their models. The range of economic and social dependencies that typify a housing market, which are largely locality specific, were then subsumed within broad-based financialization.<sup>34</sup> Although the initial result was a massive increase in profitability for entities involved in structuring asset-backed securities, the end result was the near collapse of the banking system. A process that transformed mortgage finance — one of the oldest of banking products — into a “scientific,” top-down mortgage system designed to enhance financial returns nearly destroyed the entire financial system. Of course, the credit crisis was driven by a multitude of factors,<sup>35</sup> of which credit derivatives were

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<sup>32</sup> See generally David X. Li, *On Default Correlation: A Copula Function Approach*, 9(4) J. FIXED INCOME 43 (2000) (showing that modelling the correlation of defaults in a mortgage market was one of the key issues in managing the credit risk, that the author’s work on solving this problem led the way to the massive growth in mortgage-backed securities, and that the failure of the models was central to the credit crisis); see also Philippe Jorion & Gaiyan Zhang, *Credit Contagion from Counterparty Risk*, 64(5) J. FIN. 2053 (2009) for an analysis of credit model fragility in estimated default correlations for specific obligors.

<sup>33</sup> Roger Lowenstein, *Triple-A Failure*, N.Y. TIMES (Apr. 27, 2008), <http://www.nytimes.com/2008/04/27/magazine/27Credit-t.html?ex=1366603200&en=aa00d5988f95645f&ei=5088&partner=rssnyt&emc=rss>; see also Phillippe Jorion, *Risk Management Lessons from the Credit Crisis*, 15(5) EUR. FIN. MGMT. 923 (2009); Jón Danielsson, *Blame the Models*, 4(4) J. FIN. STABILITY 321 (2008).

<sup>34</sup> Craig Burnside, Martin Eichenbaum & Sergio Rebelo, *Understanding Booms and Busts in Housing Markets* (Nat’l Bureau of Econ. Research, Working Paper No. 16734, 2011).

<sup>35</sup> Of the many factors that contributed to the subprime meltdown, one was a desire on the part of U.S. policymakers to make housing finance more available to low-income borrowers, which led to banks

only one, but in terms of the particular dynamics of the housing market and ideas about ecological resilience, the immediate parallels with the monocropping of ecosystems are striking.

The end result of the process was that banks had reduced their own resilience by homogenizing their portfolios and loading up on a commercialized, standardized product with seeming mathematical justification, without regard to the basic health of the underlying ecosystem/asset base.<sup>36</sup> This was compounded by the narrow specialization of financial roles and the segmentation of the credit process within financial institutions, which removed the incentive for a system-wide perspective. The guiding logic of securitization focused on maximizing efficiency and economic output through risk transfer, without regard to possible entropy in the system as risk was transferred through the layers of the securitization process.<sup>37</sup> The need to maintain the subtle socio-economic dynamics that supported resilience was overlooked. As Andy Haldane has commented, “[F]inancial sector balance sheets became homogenised. Finance became a monoculture. In consequence, the financial system became, like plants, animals and the ocean before it, less disease-resistant. When environmental factors changed for the worse, the homogeneity of the financial eco-system increased materially its probability of collapse.”<sup>38</sup>

This underlines the importance of understanding the complex nature of the financial system and the interlocking nature of codependent systems (financial-economic-social) as part of resilience thinking in finance. It also suggests the importance of subtle, nonfinancial processes for building and maintaining resilience—that a quest to isolate and maximize financial value may fundamentally reduce systemic resilience by weakening the underlying processes on which the financial system depends. The quest to maximize financial yield cannot be pursued on the assumption that the processes it sets in motion simultaneously maximize efficiency, human welfare, and systemic resilience. This calls into question the Financial Stability Forum’s

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seeking new ways of managing and profiting from the increased credit risk on their books.

<sup>36</sup> This comes through very clearly in accounts of the crisis, as banks/investors relied entirely on credit ratings and the outputs of risk models, without performing basic checks on the reality of the underlying housing market. *See, e.g.,* UBS, *Shareholder Report on UBS’s Write-Downs*, UBS ANNUAL GENERAL MEETING 2008, 38–41 (Apr. 18, 2008), [www.ubs.com/global/en/about\\_ubs/investor\\_relations/agm/previous-agms/2008/agm2008/invagenda.html](http://www.ubs.com/global/en/about_ubs/investor_relations/agm/previous-agms/2008/agm2008/invagenda.html).

<sup>37</sup> Entropy is a central feature of ecological interdependencies: it refers to the rate of energy loss as energy is passed through food webs and ecological systems. In contrast, theories of risk assumed that risk could be dissected, disassembled, and reassembled along the chain of intermediation without any “energy loss” or rate of dissipation. Entropy is an interesting idea to apply to finance and risk. *See* Kambhu, Weidman & Krishnan, *supra* note 19, at 25; Rongzi Zhou, Ru Cai & Guanqun Tong, *Applications of Entropy in Finance: A Review*, 15 ENTROPY 4909, 4909–31 (2013).

<sup>38</sup> Haldane, *supra* note 19, at 19.

juxtaposition of financial system resilience, efficiency, and innovation as “essential to the financial system’s contribution to economic growth.”<sup>39</sup> It also calls into question the focus of the Financial Stability Board on “fixing the fault lines that underlay the crisis” by addressing a range of narrowly financial issues: bank capital, shadow banking, more transparent derivatives markets, and ending too-big-to-fail (TBTF) through coherent resolution mechanisms.<sup>40</sup> This approach assumes the characteristics of the system that plunged the world into severe crisis are fundamentally sound, and it suggests creating a resilient financial system simply requires fixing the defects that led directly to the crisis.

#### IV. IDENTIFYING CHARACTERISTICS OF RESILIENT SYSTEMS

##### A. Panarchy

In response to the problems of overexploitation of the natural environment, ecological resilience thinking moved away from a focus on classical equilibrium, to one of *panarchy*, or multiple equilibria through which a system can transition. Panarchy has been defined as “[t]he interactive dynamics of a nested set of adaptive cycles,”<sup>41</sup> and it broadly refers to the concept that a complex ecosystem has multiple potential points of equilibrium, balanced across actors operating at multiple spatial and temporal scales, and may never in fact be at a point of optimal equilibrium.<sup>42</sup>

A resilient ecosystem is one characterized by constant mutation at different interlocking levels, from the fast change among microorganisms to slower change at the level of regional ecosystems to the geological scale over many millennia. All scales have the capacity to affect change at surrounding levels, and attempts to manage for stability at one scale can have unintended consequences at other scales. So for example, the attempt to manage forestry for the life-cycle of trees affected the life-cycle of microorganisms which in turn affected the slower process of gradual nutrient building in the soil which supported successive populations of trees. Undermining these processes altered the ability of the forest to regenerate and led to the failure of the scientific approach to forestry. Similarly with credit derivatives, the financial

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<sup>39</sup> FIN. STABILITY FORUM, *supra* note 15, at 2.

<sup>40</sup> Carney, *supra* note 16, at 3.

<sup>41</sup> Carl Folke et al., *Resilience Thinking: Integrating Resilience, Adaptability and Transformability*, 15 *ECOLOGY & SOC’Y*, no. 4, 2010, at 1, 3; *see also*, PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS 5 (Lance H. Gunderson & C.S. Holling eds., 2002).

<sup>42</sup> *See* Robert V. O’Neill, *Recovery in Complex Ecosystems*, 6 *J. AQUATIC ECOSYSTEMS STRESS & RECOVERY* 181, 184 (1999).

system became deeply unstable because financial objectives and returns were seen as an end in themselves. Little attention was paid to the broader impacts on social and economic processes of the boom in mortgage finance as financial profitability was taken as a proxy for increasing general welfare. Applying panarchy thinking to finance makes it clear that the resilience of a financial system cannot be viewed simply as the resilience of financial institutions; it is a much broader concept which draws on the deep interconnections across social, political, economic, and ecological systems.

Furthermore, the resilience of a financial system cannot be understood without understanding how it interacts with systems at higher and lower scales. For instance, the resilience of East Asia's financial system cannot be understood without an appreciation of its interactions with the global system and vice versa, and any appreciation of the resilience of Indonesia's financial system requires an assessment of its interactions with both East Asia's and the global financial systems.

Resilience "embraces change as a requisite to persist,"<sup>43</sup> and it is different from the concept of robustness, which means the capacity of a system with one broad point of equilibrium to resist crisis and return to that point. In his 1973 paper, Holling differentiated between resilience and stability:

[S]tability . . . represents the ability of a system to return to an equilibrium after a temporary disturbance; the more rapidly it returns and the less it fluctuates, the more stable it would be. But there is another property, termed resilience, that is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables.<sup>44</sup>

Stability has come to be denoted as *robustness* and this is an important differentiation in understanding resilience: robustness signifies "an ability to withstand shocks to the system," whereas resilience means an ability to "adapt and reconfigure in response to them."<sup>45</sup> Robustness implies stability is built into the system given assumptions about the magnitude of potential shocks — as is currently the case with financial risk management. So a robust system will be one designed to withstand a once in 100-year event for example, an approach used in risk management. In contrast resilience makes no assumptions about the magnitude of possible shocks, but rather looks to

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<sup>43</sup> Folke et al., *supra* note 41, at 1.

<sup>44</sup> Holling, *supra* note 23, at 14.

<sup>45</sup> Marc Welsh, *Resilience and Responsibility: Governing Uncertainty in a Complex World*, 180 GEOGRAPHICAL J. 15, 20 (2014).

build systems that can deal with the entire range of shocks, and fail safely if they must.

Robustness has a static quality, whereas resilience is more dynamic.<sup>46</sup> Resilience is more open to the possibility of broad systemic change within defined parameters—that a system will have different potential equilibria and may cope with a shock by returning to a different equilibrium than before. Indeed, resilience stresses the importance of this flexibility as essential to system stability: it is this very capacity of the system to move from one point of equilibrium to another that is essential to its resilience. Resilience is therefore a view of a system as inherently heterogeneous and characterized by response diversity which enables the system to cope with shocks: “the stability of [social-ecological systems] is conceptualized as a moving baseline made up of multiple states rather than a static pit in which systems strive to remain.”<sup>47</sup>

In this sense, regulating for resilience implies the need for regulations which maintain adaptive flexibility or adaptive governance. Applying such resilience thinking is challenging, not least because it is not entirely clear from regulatory documents which type of stability/robustness/resilience the current postcrisis regulatory reforms are aimed at. Do they aim to protect and underpin the status quo—on the basis that the current system is fit for purpose save for key defects which led to the global financial crisis—or is there a more fundamental agenda of reform that is necessary for global financial stability? What would a state of multiple equilibria look like in finance, and could regulation accommodate it? For example, it has been pointed out that bank runs are entirely rational<sup>48</sup> and that they represent the system flipping from one equilibrium to another,<sup>49</sup> and yet they are a classic example of the type of undesirable panic/crisis event that policymakers seek to prevent and that work on systemic stability attempts to prevent. Work is therefore needed

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<sup>46</sup> “Contrary to resilience, robustness does not include the ability to reorganize . . . and instead is seen as a (static) system property.” Roland W. Scholz, Yann B. Blumer & Fridolin S. Brand, *Risk, Vulnerability, Robustness, and Resilience from a Decision-Theoretic Perspective*, 15 J. RISK RES. 313, 319 (2012). The terms are sometimes used interchangeably. See, e.g., Kambhu, Weidman & Krishnan, *supra* note 19 (using the term robustness to describe complex adaptive systems).

<sup>47</sup> Muriel Cote & Andrea J. Nightingale, *Resilience Thinking Meets Social Theory: Situating Social Change in Socio-Ecological Systems (SES) Research*, 36 PROGRESS IN HUM. GEOGRAPHY 475, 478 (2012).

<sup>48</sup> As Mervyn King commented to Alistair Darling, British Chancellor of the Exchequer, during the run on Northern Rock in 2007: “They’re behaving perfectly rationally, you know.” HUGH PYM, *INSIDE THE BANKING CRISIS: THE UNTOLD STORY* 35 (2014).

<sup>49</sup> The maturity transformation performed by banks creates multiple possible equilibria, and bank runs have been characterized as “an undesirable equilibrium” which can result from the illiquidity of assets and information asymmetries that characterize deposit-taking banking systems. Douglas W. Diamond & Philip H. Dybvig, *Bank Runs, Deposit Insurance, and Liquidity*, 24 Q. REV. FED. RES. BANK MINNEAPOLIS 14, 15 (2000).



to determine what a multiple-equilibria regulatory model would look like. It would at least be helpful if regulators could clarify how they perceive resilience in the postcrisis reform agenda. What, for example, does the Financial Stability Board mean by stating that strengthened international regulation is “building more resilient financial institutions and more robust markets?”<sup>50</sup>

Resilience thinking moves away from the simple equilibrium of classical economics and works instead from the premise of a system’s adaptive capacity for overall stability through multi-scalar internal instability, flexibility, and adaptability. Applying such thinking about resilience to finance therefore raises pointed questions about the suite of modern financial theories that underpin the markets, which have been constructed on the premise of a single equilibrium system.<sup>51</sup> These theories broadly assume that economies and markets are stable and have a point of equilibrium to which the system will naturally tend but are periodically and only temporarily punctuated by disruption.<sup>52</sup> This is typified by the Value at Risk approach to risk management, based on the Gaussian bell curve distribution of risk/returns which assumes that they are normally clustered around the mean. Tail risk then becomes an outlier in an otherwise relatively stable system.

Rather than viewing the challenge of systemic risk through the assumption that markets efficiently and rationally price assets for financial stability in the normal course of events—and are only intermittently interrupted by cataclysmic crises which cannot be predicted from within the market’s own frame of reference—resilience would appear to require a cognitive approach that gives a central role to constant flux and disequilibrium across the markets, “[f]or what is resilience but the notion of disequilibrium as a general organising principle?”<sup>53</sup>

From this perspective, the focus of system governance—and the management of episodes of disruption—should not necessarily be to return

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<sup>50</sup> Carney, *supra* note 16, at 1.

<sup>51</sup> See, e.g., Robert C. Merton & Zvi Bodie, *Design of Financial Systems: Towards a Synthesis of Function and Structure*, 3 J. INV. MGMT. 1, 1–23 (2005) (discussing institutional design of financial architecture in light of frictionless neoclassical equilibrium and the rational behavior of agents); Olivier Blanchard, *Where Danger Lurks*, 51 FIN. & DEV. 28, 28–31 (2014).

<sup>52</sup> For an overview of how modern financial theory contributed directly to the crisis and malfunctioning of the system, see, KEVIN DOWD & MARTIN O. HUTCHINSON, *ALCHEMISTS OF LOSS: HOW MODERN FINANCE AND GOVERNMENT INTERVENTION CRASHED THE FINANCIAL SYSTEM* (2010). As Haug & Taleb have commented: “theories about practice should arise from practice[] or at least avoid conflict with it. This explains our concern with the ‘scientific’ notion that practice should fit theory.” Espen Gaarder Haug & Nassim Nicholas Taleb, *Option Traders Use (Very) Sophisticated Heuristics, Never the Black-Scholes-Merton Formula*, 77 J. ECON. BEHAV. ORG. 97, 97 (2011).

<sup>53</sup> Walker & Cooper, *supra* note 4, at 154.

the system to the pre-existing point of equilibrium (if a point of financial system equilibrium can indeed be identified) as is the case with current regulatory thinking. Resilience thinking in ecology requires the acceptance of notions of inherent instability and flux as the actions of agents continually evolve to reshape the dynamics of the system. It requires governance around dynamic flexibility because resilience depends on “diversity in norms, institutions, laws, incentive structures and behavioural practices. Market competition [in contrast] favors productivity but leads to diversity loss which cripples the system’s ability to adapt to change.”<sup>54</sup>

### B. Hysteresis

Another concept that is closely linked to the challenge of managing for dynamic flexibility around panarchy, or multiple equilibria, is the notion of *hysteresis*. Hysteresis in ecology refers to the energy changes within a system as it moves between equilibria, which can have a decisive effect on its recovery trajectory after shock. The recovery path of a system following a change in state can be very different from the path it took during the change in state because the energy required to return a system to its previous state may be much greater than the energy required to bring about the original change. Hysteresis means that as a system moves from point A to point B, it loses energy or the energy dynamics change such that it may not automatically shift back to point A: “[o]nce the system has shifted to a new stable equilibrium, simply removing the stress will not automatically produce recovery.”<sup>55</sup>

Linking to the notion of panarchy, hysteresis in complex adaptive systems means that it cannot be assumed that the balance or particular configuration of the system prior to a stress event is in fact its natural state to which it will naturally return after a crisis, or to which the system should be returned with targeted postcrisis management. Hysteresis and panarchy stress the transient nature of systems:

The study of scale effects demonstrates with great clarity that nature is dynamic, always changing at various scales of space and time. Ecologists study what appear to be discrete ecosystems often giving the appearance of being in equilibrium (i.e., “balanced”) but which are, in reality, small segments of a temporal and spatial

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<sup>54</sup> Simon Levin et al., *Social-Ecological Systems as Complex Adaptive Systems: Modeling and Policy Implications*, 18 ENV’T & DEV. ECON. 111, 126 (2013).

<sup>55</sup> O’Neill, *supra* note 42, at 185.

continuum . . . .<sup>56</sup>

The point of managing a system for resilience, then, may not be to return it to its original point of perceived balance but to accept that it may settle elsewhere postcrisis. As such, “the resilience perspective shifts policies from those that aspire to control change in systems assumed to be stable, to managing the capacity of social-ecological systems to cope with, adapt to, and shape change.”<sup>57</sup>

Applying this to financial governance and regulatory reform would suggest a shift in conceptualizing the purpose of regulation beyond a focus on restoring market equilibrium to the precrisis situation. In the case of a bank run such as Northern Rock, for example, should the role of the regulator be to intervene to save what can be salvaged of the bank? Or should it be accepted that the system has shifted to a new equilibrium, and in doing so has lost energy (the reputation of the bank’s brand) such that efforts to return it to its former equilibrium as a functioning bank should not be pursued? Similar questions can be asked about policies to support particular markets and efforts to restore their functioning postcrisis.

### C. Adaptive management around dynamic, interlocking systems

Managing for resilience requires a fundamentally different approach to system governance than managing for stability around an assumed point of equilibrium. It requires dynamic management which aims to maintain flexibility in the system and scope for internal change—and to allow such organic change—rather than seeking to limit change and maintain the status quo on the basis that the underlying markets are efficient. It requires adaptive rather than static management which accepts and allows postcrisis adaptation in the system. Partly this stems from a need to accept the uncertain dynamic of “interactions between slow-moving and fast-moving processes and between processes that have large spatial reach and processes that are relatively localized.”<sup>58</sup> Managing for systemic stability around only one scale or assumed point of equilibrium can have impacts on other interlocking scales or processes, which can in turn destabilize the system and undermine resilience. By managing for stability, resilience can be reduced: “[c]omplex systems that have artificially suppressed volatility tend to become extremely

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<sup>56</sup> KIRCHNER, *supra* note 24, at 109–10.

<sup>57</sup> Carl Folke, *Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses*, 16 GLOBAL ENVTL. CHANGE 253, 254 (2006) (citation omitted).

<sup>58</sup> C. S. Holling, Lance H. Gunderson & Donald Ludwig, *In Quest of a Theory of Adaptive Change*, in PANARCHY: UNDERSTANDING TRANSFORMATION IN HUMAN AND NATURAL SYSTEMS (L. H. Gunderson & C. S. Holling eds., 2002) 3, 9.

fragile, while at the same time exhibiting no visible risks.”<sup>59</sup>

Yet to date, financial regulation has focused almost exclusively on financial system stability by reducing volatility and strengthening the viability of financial institutions using prescriptive metrics for risk weighting of assets, capital adequacy, liquidity, etc. Key regulatory debates are framed almost entirely from this vantage point, without taking into account (i) the impact of financial system dynamics on other interlinked processes and systems which can create unanticipated feedback loops for financial system stability, or (ii) the unintended consequences of trying to manage for stability in a complex adaptive system.

An example is the impact of the global asset bubble of 2005–2007 on localized political structures, which in turn created new systemic vulnerabilities. Management of the financial system in those years assumed the success of financial innovation and new trading opportunities. From the purely financial point of view from which financial stability work was then focused, this was underpinned by the lack of market shocks during that period and the rise in returns and profitability at financial institutions, both of which were taken as signs of health in the financial system. However, the global boom created severe economic stress across the world, raising the cost of living, as the growing trading in commodity derivatives created a global food crisis that triggered political unrest in several developing countries.<sup>60</sup>

A threshold effect of this process could be seen in the events of December 2010 and after, when a Tunisian fruit seller immolated himself in protest at repressive police treatment and the stress that rising costs and disparities in growth were placing on his livelihood, sparking the first of the Arab revolts.<sup>61</sup> Yet the consequences were the destabilization of financial markets globally. Multi-scalar effects are evident here: poverty, global development, and political reform are generally slow-moving processes that are managed separately from financial stability because they operate on a different scale and are institutionalized in different forums.<sup>62</sup> However, their

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<sup>59</sup> Nassim Nicholas Taleb & Mark Blyth, *The Black Swan of Cairo: How Suppressing Volatility Makes the World Less Predictable and More Dangerous*, 90 FOREIGN AFF. 33, 33 (2011).

<sup>60</sup> See Marco Lagi, Karla Z. Bertrand & Yaneer Bar-Yam, *The Food Crisis and Political Instability in North Africa and the Middle East*, NEW ENGLAND COMPLEX SYS. INST. (2011), [http://necsi.edu/research/social/food\\_crises.pdf](http://necsi.edu/research/social/food_crises.pdf); Olivier De Schutter, *Building Resilience: A Human Rights Framework for World Food and Nutrition Security*, at 9, U.N. Doc. A/HRC/9/23 (Sept. 8, 2008). In April 2008 the United Nations created a High Level Task Force on the Global Food Security Crisis. See *High Level Task Force on Global Food and Nutrition Security*, UNITED NATIONS, <http://www.un-foodsecurity.org> for details.

<sup>61</sup> Mohamed A. El-Khawas, *Tunisia's Jasmine Revolution: Causes and Impact*, MEDITERRANEAN Q., Fall 2012, at 23 (“The spark that ignited the uprising was not a cry for democracy but a demand for jobs.”).

<sup>62</sup> As Jeffrey Sachs noted, “we have trillions of dollars directed at banks and bail-outs but we’re told

interdependencies create dynamic feedback loops that require integrative management strategies around flexibility that take into account multi-scalar effects and the possibility of transmission of vulnerabilities across different scales and different interlocking systems. Arguably, network interconnectivity such as this requires broader thinking around the real meaning of financial stability. It is not enough to simply embed country risk or political risk as a discrete category of the risk management framework so as to manage financial loss on a particular transaction or define risk limits for exposures.

Resilience in this sense is a challenge to the limits of current thinking about the objectives of financial regulation, which focus purely on the dynamics of the financial system itself and outcomes for system participants. It fails to take into account the dynamics of symbiotically mutating systems which are all nonlinear and nested, i.e. embedded in each other. Systemic stability has been understood as an issue of business continuity at financial institutions (particularly for systemically important financial institutions) and stability across various financial markets. Drawing on resilience in social-ecological systems science would indicate that to truly understand dynamic resilience in finance, it cannot be framed from such a limited point of view, particularly with globalized markets. Instead, it requires a perspective that captures financial system dynamics in interaction with multiple other dynamic systems: legal, political, ecological, cultural, institutional, etc. These are all in turn complex adaptive systems evolving at their own rate. Applying resilience thinking to finance therefore arguably requires a broad theoretical expansion far beyond the current technical limits of the financial stability debate to incorporate a more expansive cognitive map of the factors that ultimately impact upon financial system stability. It raises broad public policy questions around how we can or should define an optimal financial system, and in particular whether the expansion of global financial markets is an end in itself, even if it destabilizes other systems on which it ultimately depends.

As persuasive as the idea of adaptive governance is, it is complex to apply as a management tool in finance because an adaptive system can inherently adapt to the properties of its own governance regime. The financial system does already display properties of such adaptive behavior, which can help pre-pave the conditions for the next crisis. Following the South East Asian crisis of 1997–1998, for example, the countries involved began

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there's nothing for the poor. Meanwhile, we are teetering on the brink of collapse and violence in parts of the world where people have been pushed to the brink."Harvey Morris, *Forgotten Victims of the Global Downturn*, FIN. TIMES (Mar. 10, 2009), <https://www.ft.com/content/79556b02-0db3-11de-8ea3-0000779fd2ac>.

stockpiling foreign currency reserves and keeping their currencies low against the dollar to encourage exports. This was one factor that fueled global liquidity and global imbalances that in turn contributed to the global credit bubble.<sup>63</sup> Although the South East Asian countries, as with many developing countries, were able to weather the storm of the crisis reasonably well, the currency imbalances helped stoke problems elsewhere, highlighting the interdependencies at different ranges and scales that have come about through integration of global markets. This raises the question: “Does the resilience of some livelihoods result in the vulnerability of others?”<sup>64</sup> How should the system be managed to take into account these effects? If the system is managed purely around the stability and profitability of financial system participants, should the impact of financial flows on standards of living and global livelihoods be a matter for financial system regulation, or should it continue to be ancillary to regulatory mandates? Clearly, the way we define system resilience is as important as the way we manage for it.

#### D. Resilience and “efficient” markets

Resilience and the notion of panarchy therefore offer a different cognitive paradigm for systemic risk analysis and questions of market stability than the current intellectual framework, and they raise pointed questions about the ideas that have dominated financial theory over previous decades: equilibrium, efficient markets, and the assumption of a normal (Gaussian) probability distribution of returns in which the whole spectrum of risks are calculable in a meaningful way.<sup>65</sup> If markets are in constant flux and features of the system are dynamically shifting in unpredictable ways, does the theory that they efficiently price assets through the incorporation of all relevant information at any given point actually fit, or do we need to conceive of the system in radical new ways? Do pricing signals effectively convey the information necessary for market participants to make decisions that promote resilience? The fluidity of a complex adaptive and resilient system would imply that financial markets may not be characterized by the stability of the relationships between actors and risk factors that drive a market and that the efficient market hypothesis requires.<sup>66</sup> Instead, markets are conceived as

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<sup>63</sup> Maurice Obstfeld & Kenneth Rogoff, *Global Imbalances and the Financial Crisis: Products of Common Causes*, FED. RESERVE BANK OF S.F. (Oct. 19, 2009), [http://www.frbsf.org/economic-research/files/Obstfeld\\_Rogoff.pdf](http://www.frbsf.org/economic-research/files/Obstfeld_Rogoff.pdf).

<sup>64</sup> Cote & Nightingale, *supra* note 47, at 482.

<sup>65</sup> Esteban P. Caldentey & Matías Vernengo, *Modern Finance, Methodology and the Global Crisis*, 52 REAL-WORLD ECON. REV. 69, 69–81 (2010).

<sup>66</sup> Economists “might say ‘get the prices right’ without recognizing that price systems require a stable context where social and ecosystem processes behave ‘nicely’ in a mathematical sense (i.e., are continuous

dynamically nonlinear in functioning:

Theories of complex systems portray systems not as deterministic, predictable and mechanistic, but as process-dependent organic ones with feedbacks among multiple scales that allow these systems to self-organize . . . . The study of complex adaptive systems attempts to explain how complex structures and patterns of interaction can arise from disorder through simple but powerful rules that guide change.<sup>67</sup>

If the markets are dynamically nonlinear and liable to flip from one equilibrium to another in unexpected ways, a wholesale rethink of the intellectual architecture of risk will arguably be necessary—from an assumption of calculable uncertainty to an acceptance of incalculable uncertainty.<sup>68</sup> Nonlinearity, multiple equilibria and the dynamic uncertainty of constant change challenge the utility of reliance on probability and a normal distribution of returns as a baseline for risk management because it implies that the system is constantly shifting and mutating—that it is not amenable to a probability-type assessment. This raises the question whether risks can be meaningfully assessed and managed in a constantly changing system, or whether attempting to do this in a complex dynamic system pushes risk into the statistical tails, creating “silent risks [that] accumulate beneath the surface.”<sup>69</sup> If risk cannot be meaningfully measured, this would call into question the current architecture of risk weighted capital adequacy, which requires a calculable distribution of risk which can be measured and hedged across the spectrum of asset classes.

One major problem with the current regulatory approach to stability/resilience in the financial markets, then, is that as it assumes inherent stability in the distribution of returns it systematically downplays the likelihood of tail risk events, which it cannot address from within its own framework.<sup>70</sup> A resilience approach to risk management that accepts the nature of finance as a complex, nonlinear system would imply a need for a more dynamic model that focuses on the constantly shifting, dynamic interplay of system

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and convex) . . . without recognizing the surprises that nature and people inexorably and continuously generate.” PANARCHY: UNDERSTANDING TRANSFORMATIONS IN HUMAN AND NATURAL SYSTEMS, *supra* note 41, at xxi–xxii.

<sup>67</sup> Folke, *supra* note 57, at 257 (citation omitted).

<sup>68</sup> Nina Boy, J. Peter Burgess & Anna Leander, *The Global Governance of Security and Finance: Introduction to the Special Issue*, 42(2) SECURITY DIALOGUE 115, 115–122 (2011). This links into N. N. Taleb’s thinking on risk and randomness in financial markets. See NASSIM N. TALEB, FOOLED BY RANDOMNESS: THE HIDDEN ROLE OF CHANCE IN LIFE AND IN THE MARKETS (2nd ed., 2005); NASSIM N. TALEB, THE BLACK SWAN: THE IMPACT OF THE HIGHLY IMPROBABLE (2007).

<sup>69</sup> Taleb & Blyth, *supra* note 59, at 33.

<sup>70</sup> Kevin Dowd et al., *How Unlucky is 25-Sigma?*, 34(4) J. PORTFOLIO MGMT. 76, 76–80 (2008).

participants and factors that are constantly shaping the potential outcomes of the system in subtle ways. It would require a focus on the influence of different scales and different interacting systems on risk. It is inadequate to focus on market data as the primary vehicle for assessing risk, and outcomes for system participants alone. Risk then moves from being a calculable uncertainty to an incalculable uncertainty:

A new epistemic condition of deep or radical uncertainty has come to dominate . . . because the increased interconnection and complexity of ‘traffic’ and communication – be it financial in the form of credit channels, transport-based as in the aviation system, or biological as in the spread of pandemics – vastly increases exposure to rare events that exceed calculability and shatter existing provisions of crisis management and insurance.<sup>71</sup>

Considering the dynamics of resilience within social-ecological systems indicates the need for a radical shift in thinking about risk in finance. This would need to move away from statistical modelling of market and economic data on the assumption of a reasonably stable distribution of returns to a framework that is more fluid, better able to aggregate risks across markets, and better able to understand the interplay of risk across different interlocking systems.

Although a rethinking of risk around a deeper understanding of resilience is arguably essential, it is clearly problematic at the same time because it would require fundamental changes to the current cognitive architecture of risk. Recovery trajectories in complex systems are unique because the system is always evolving, and “the complexity of the system combined with unanticipated compounded effects can make recovery trajectories difficult or impossible to predict. The system may look similar but it is not the same system, because like any living system it is continuously developing.”<sup>72</sup> Given the realities of today’s markets, a more fluid, less deterministic approach to risk management (whatever operational form that may take) may be far more useful than the statistical assumption of normal returns. The oversupply of global liquidity, the global hunt for yield by investors, the prevailing narratives of financial analysts, the dynamics of risk management and capital adequacy regulations, the existing monetary policies, and the size of the financial economy relative to the real economy are all factors internal to the financial markets that affect values, risks, and financial stability and raise questions over the efficient pricing of capital by market participants. As has been commented:

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<sup>71</sup> Boy et al., *supra* note 68, at 117.

<sup>72</sup> Folke, *supra* note 57, at 257 (citation omitted).



Capital superabundance will increase the frequency, intensity, size and longevity of asset bubbles. The propensity for bubbles to form will be magnified as yield-hungry investors race to pour capital into assets that show the potential to generate superior returns. Because the global financial system has grown so large relative to the underlying economy, asset values can quickly reach unsustainable levels and remain inflated for months or years.<sup>73</sup>

Developing a global risk architecture suited to this type of constant change and incalculable uncertainty, as well as the influence of resilience across multiple interlocking systems, must be part of a resilience agenda which can provide a meaningful way of managing systemic change.

#### E. Heterogeneity: building resilience on diversity

A further factor that SES resilience thinking emphasizes is the essential heterogeneity of system participants and behavior as a crucial component of the capacity of systems to reorganize in the face of shocks.

The simplest intuitive case contrasts a competitive system in homogeneous versus heterogenous space. . . . [H]omogeneity leads to a single equilibrium in which the dominant population eliminates all others. Heterogeneity, combined with limited dispersion, allows multiple competitors to coexist, each within a local cell. The result is that the total community, summed across the spatial heterogeneity, can have a number of stable states, depending on the heterogeneity.<sup>74</sup>

This contrasts with the noted tendency of the international finance architecture and financial theories to produce homogenized behavior of system participants, even though the theories themselves fail to account for the homogenizing tendency on participant behavior of their widespread uptake.<sup>75</sup> The standardization of global rules of financial regulation has also been argued to reduce systemic diversity by mandating the harmonization of procedures and management within financial institutions. As leading commentators warned over a decade ago about the proposed Basel II

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<sup>73</sup> Karen Harris, Andrew Schwedel & Austin Kim, *A World Awash in Money*, BAIN & COMPANY: INSIGHTS 4 (Nov. 14, 2012), <http://www.bain.com/publications/articles/a-world-awash-in-money.aspx>.

<sup>74</sup> O'Neill, *supra* note 42, at 183 (citation omitted).

<sup>75</sup> Homogenization has even been argued as strengthening the system: "When financial institutions become more homogenous, the need for inter-institutional risk sharing is lowered. Any imperfections such risk sharing may be subject to are hence mitigated. Moreover, institutions then need to rely less on such risk sharing, which reduces externalities among them. This, in turn, improves their incentives and lessens the need for regulating them." Wolf Wagner, *The Homogenization of the Financial System and Financial Crises*, 17 J. FIN. INTERMEDIATION 330 (2008).

regulations: “Of special concern is how the proposed regulations would induce the harmonisation of investment decisions during crises with the consequence of *destabilising* rather than *stabilising* the global financial system.”<sup>76</sup>

The homogenization of participant behavior is also exacerbated by the use of similar benchmarks for performance, and similar analytical and valuation techniques drawn from the same financial theories and narratives of market trends. As a result, financial behavior becomes highly correlated under stress, leading to one-way markets in response to shocks that destabilize financial structures and serve as a conduit for the transmission of problems from one market sector to another.<sup>77</sup> Rather than the market mechanism serving to contain the forces of crisis by bringing heterogeneous buyers and sellers together, the standardization of practice through harmonized rules, theories, and benchmarks reinforces a crisis and exacerbates its global impact.

The drive to standardize the regulation and governance of the system around what is perceived to be best practice and cutting edge financial theory, therefore, may lead to diminished systemic resilience. Efforts to build greater resilience must focus on fostering heterogeneity such that “competitive advantage shifts among species and never remains constant long enough to permit dominance or elimination.”<sup>78</sup> Heterogeneity being essential to systemic resilience raises questions over the current approach of the Basel Committee on Banking Supervision, which is pursuing a Regulatory Consistency Assessment Programme. This is based on the assumption that “[c]onsistent implementation of the Basel framework is fundamental in raising the resilience of the global banking system.”<sup>79</sup> Yet the standardized international capital adequacy framework and risk models were identified during the crisis as having failed to build adequate reserves into the system.<sup>80</sup> How consistent implementation of the new framework will deliver resilience is not articulated, beyond the fact it will maintain “market confidence in regulatory ratios” and provide “a level playing field for internationally

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<sup>76</sup> JON DANIELSSON ET AL., AN ACADEMIC RESPONSE TO BASEL II: SPECIAL PAPER NO. 130 3 (2001), <http://www.bis.org/bcbs/ca/fmg.pdf>.

<sup>77</sup> Charles Goodhart & Wolf Wagner, *Regulators Should Encourage More Diversity in the Financial System*, VOX (Apr. 12, 2012), <http://www.voxeu.org/article/regulators-should-encourage-more-diversity-financial-system>; MARKUS BRUNNERMEIER ET AL., THE FUNDAMENTAL PRINCIPLES OF FINANCIAL REGULATION: GENEVA REPORT ON THE WORLD ECONOMY NO. 11 (2009).

<sup>78</sup> O'Neill, *supra* note 42, at 183.

<sup>79</sup> BASEL COMM. ON BANKING SUPERVISION, REGULATORY CONSISTENCY ASSESSMENT PROGRAMME (RCAP) – ANALYSIS OF RISK-WEIGHTED ASSETS FOR MARKET RISK 5 (2013).

<sup>80</sup> See, e.g., JAMES ALEXANDER ET AL., VERDICT ON THE CRASH: CAUSES AND POLICY IMPLICATIONS (Philip Booth ed., 2009).

operating banks.”<sup>81</sup>

The need for heterogeneity also raises the question of whether a system can be truly resilient when it is dominated by a cadre of TBTF financial institutions that benefit from substantial public guarantees that ensure their survival, despite the negative externalities they generate pursuing their own private gains. Arguably, this is inimical to systemic resilience: in multiple equilibria ecological systems “[l]ocal conditions change so rapidly that competitive advantage shifts among species and never remains constant long enough to permit dominance or elimination.”<sup>82</sup> After the crisis, improving competition among the banking industry has been a theme of public policy debates, yet with the efforts to underpin banking giants in many countries and the special global regulation of systemically important financial institutions, the effects on competition are questionable.<sup>83</sup>

TBTF financial institutions are justified on the basis of economies of scale. However, much recent research has questioned whether economies of scale in banking diminish beyond a certain size, and are offset by the management and governance problems created by greater institutional complexity and lack of transparency of risks.<sup>84</sup> Furthermore, the global negative externalities TBTF banks generated during the crisis raise questions over whether further embedding the dominance of TBTF financial institutions through creating a targeted regulatory regime assists or undermines resilience. Given the strain on public sector balance sheets in the advanced economies, if the regulatory measures targeted at TBTF financial institutions fail, there is little scope for further public bailouts. Such institutions, therefore, pose critical ongoing risks to the health of the international financial system. It may well be that a thorough understanding of resilience in financial systems will establish that no system can be truly resilient if it contains institutions that are TBTF.

One regulatory approach that could enhance systemic resilience is the

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<sup>81</sup> BASEL COMM. ON BANKING SUPERVISION, *supra* note 79.

<sup>82</sup> O'Neill, *supra* note 42, at 183.

<sup>83</sup> BASEL COMM. ON BANKING SUPERVISION, GLOBAL SYSTEMICALLY IMPORTANT BANKS: UPDATED ASSESSMENT METHODOLOGY AND THE HIGHER LOSS ABSORBENCY REQUIREMENT (2013). Twenty-nine banks have currently been identified as systemically important banks. FIN. STABILITY BD., 2013 UPDATE OF GROUP OF GLOBAL SYSTEMICALLY IMPORTANT BANKS (2013), [http://www.fsb.org/2013/11/r\\_131111/](http://www.fsb.org/2013/11/r_131111/).

<sup>84</sup> Andrew G. Haldane, Exec. Dir. of Fin. Stability, Bank of Eng., Speech delivered at the Institute of Economic Affairs, London: On Being the Right Size (Oct. 25, 2012), <http://www.bis.org/review/r121030d.pdf>; Robert DeYoung, *Scale Economies Are a Distraction*, FED. RESERVE BANK OF MINNEAPOLIS: THE REGION 14–16 (Sept. 2010); Arnoud W.A. Boot, *Banking at the Crossroads: How to Deal With Marketability and Complexity*, 1 REV. DEV. FIN. 167, 167–83 (2011); RONALD W. ANDERSON & KARIN JOEVEER, BANKERS AND BANK INVESTORS: RECONSIDERING THE ECONOMIES OF SCALE IN BANKING: DISCUSSION PAPER NO. 712 (2012), <http://www.lse.ac.uk/fmg/workingPapers/discussionPapers/fmgdps/dp712.pdf>.

work to develop an effective and credible resolution regime for TBTF financial institutions—living wills.<sup>85</sup> Living wills are designed to respond to the particular dominance of these institutions by building a process of bankruptcy or restructuring that will allow the institutions to be wound up in an orderly way without requiring public funds or destabilizing the markets. The fact that such companies require living wills indicates how far from resilient the system actually is, but if living wills can be successfully implemented, they will surely enhance the resilience of the financial system by expanding the capacity of markets for self-renewal in the face of shocks.<sup>86</sup>

Living wills depend upon effectively anticipating the types of stress events that may occur and how they would impact an organization. If done well, stress testing will enhance financial institution resilience in the SES sense because it builds dynamic responsiveness to changing conditions into the heart of the organization. It can also build a capacity in the organization to anticipate and reconfigure in the face of market shocks, particularly if used effectively in terms of capital budgeting and risk appetite planning. However, translating a resolution procedure from theory to practice is far from easy given the complexity and opacity of these organizations. The next major crisis may teach us that living wills, while fine on paper, do little to limit contagion and corral systemic risk in an actual crisis.

One segment of the financial markets that has displayed resilience in the ecological sense in recent years is the hedge fund industry.<sup>87</sup> The collapse of Long-Term Capital Management (LTCM) in 1998 is often used to illustrate the dangers of hedge funds. However, in practice, the dynamics of the sector are very different from that of the global banking industry: there is a very high attrition rate among funds that largely passes unnoticed, does not cause systemic ripples, and does not require taxpayer-funded bailouts. Even LTCM was bailed out by private sector financial institutions at the instigation of the Federal Reserve, rather than by an injection of public funds.<sup>88</sup> According to

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<sup>85</sup> *Key Attributes of Effective Resolution Regimes for Financial Institutions*, FIN. STABILITY BD. [http://www.fsb.org/2014/10/r\\_141015/](http://www.fsb.org/2014/10/r_141015/), (Oct. 15, 2014); Directive 2014/59/EU, of the European Parliament and of the Council of 15 May 2014 Establishing a Framework for the Recovery and Resolution of Credit Institutions and Investment Firms, 2014 O.J. (L 173); IMF, *Cross-Border Bank Resolution: Recent Developments*, Board Paper (June 2014).

<sup>86</sup> Such living wills are difficult to translate from theory into workable plans given the scale and complexity of TBTF institutions and the cross-border issues involved. See Thomas M. Hoenig, Vice Chairman, Fed. Deposit Ins. Corp., Statement: Credibility of the 2013 Living Wills Submitted by First Wave Filers (Aug. 5, 2014); Emiliós Avgouleas, Charles Goodhart & Dirk Schoenmaker, *Bank Resolution Plans as a Catalyst for Global Financial Reform*, 9 J. FIN. STABILITY 210, 210–18 (2013); IMF, *The Too-Important-to-Fail Conundrum: Impossible to Ignore and Difficult to Resolve*, Staff Discussion Note (May 27, 2011).

<sup>87</sup> Hedge funds are alternative investment funds that invest using bespoke, proprietary investment strategies to try to generate higher returns than those produced by standard asset managers.

<sup>88</sup> U.S. DEP'T OF THE TREASURY, HEDGE FUNDS, LEVERAGE, AND THE LESSONS OF LONG-TERM

a recent report, in the five years prior to 2014, half of all hedge funds were found to have closed, and the average life of a hedge fund that survived its first year of operation was just over five years.<sup>89</sup> The UK's Financial Conduct Authority has commented: "Hedge funds fail or close down on a regular basis without causing a significant impact on the financial system, but [the few] very large hedge funds potentially pose a risk."<sup>90</sup> It is noteworthy that the sector displays very different characteristics from the global banking industry. Hedge fund assets under management are roughly USD two trillion.<sup>91</sup> In comparison, the top five largest banks in the world have over USD thirteen trillion in assets.<sup>92</sup> The hedge fund industry is also characterized by many small funds, with nearly ninety percent of funds managing less than USD 500 million in assets.<sup>93</sup> The sector operates on much higher leverage than the banking industry—average leverage was estimated at 130% in 2012, down from 150% in 2010—but is characterized by regular fund liquidations which do not impact market stability.<sup>94</sup> As part of a resilience research agenda, further investigation of the relative dynamics of the banking and hedge fund sectors may prove fruitful.

Such a study may shed light on the role of regulation in shaping market dynamics, for the latest crisis at least has been centered on highly regulated financial institutions.<sup>95</sup> The failures of regulation and supervision have come in for heavy criticism following the crisis, and the postcrisis regulatory response has also been criticized as not going far enough. The response has been characterized as being insufficient to have prevented the latest crisis, let alone the next one.<sup>96</sup> The dynamics of the regulatory and supervisory process as in itself a complex, adaptive system may need to be examined in light of

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CAPITAL MANAGEMENT: REPORT OF THE PRESIDENT'S WORKING GROUP ON FINANCIAL MARKETS (1999), <http://www.treasury.gov/resource-center/fin-mkts/documents/hedgfund.pdf>; Franklin R. Edwards, *Hedge Funds and the Collapse of Long-Term Capital Management*, 13(2) J. ECON. PERSP. 189, 189–201 (1999).

<sup>89</sup> Dan McCrum, *Zombie hordes thrive, await further hedge fund corpses*, FT ALPHAVILLE (Mar. 25, 2014, 10:14 AM), <http://ftalphaville.ft.com/2014/03/25/1810462/zombie-hordes-thrive-await-further-hedge-fund-corpse/> (citing data from Hedge Fund Research).

<sup>90</sup> FIN. CONDUCT AUTH., HEDGE FUND SURVEY: MARCH 2014 4 (2014).

<sup>91</sup> THECITYUK, HEDGE FUNDS REPORT 2013, 1 (2013).

<sup>92</sup> Maria Tor & Saad Sarfraz, *Largest 100 Banks in the World*, SNL (Dec. 23, 2013), <https://www.snl.com/InteractiveX/Article.aspx?cdid=A-26316576-11566>.

<sup>93</sup> THECITYUK, *supra* note 91, at 5 chart 13.

<sup>94</sup> *Id.* at 6.

<sup>95</sup> Of course, credit default swaps were unregulated products that were part and parcel of the failures at large financial institutions like AIG, Citigroup, etc.

<sup>96</sup> Douglas W. Arner, *Adaptation and Resilience in Global Financial Regulation*, 89 N.C. L. REV. 1579, 1579–1628 (2011); Alex. J. Pollock, *Lots of Regulatory Expansion but Little Reform*, AMERICAN ENTERPRISE INSTITUTE (June 22, 2010), <https://www.aei.org/publication/lots-of-regulatory-expansion-but-little-reform/>; Ross P. Buckley, *The G20's Performance in Global Financial Regulation*, 37(1) UNSW L.J. 63, 63–93 (2014).

a resilience research agenda, and the limits of what regulation may be able to achieve honestly assessed. As had been pointed out about the process of drafting the Basel framework: such international regulation is produced by a “highly politicized committee process[,] . . . [which is] the product of innumerable arbitrary decisions, irrational compromises, and political horse-trades – not to mention the personalities and prejudices of the main participants involved.”<sup>97</sup>

Adaptive governance of the complex adaptive financial system through the medium of a legal framework also therefore needs to take into account the complex, adaptive nature of the law: “The legal system comprises a multitude of institutions and actors interacting and evolving over time in ways that give rise to complex system dynamics. . . . [P]utting panarchy theory into practice will require adaptively managing the complex adaptive legal system to adaptively manage other complex adaptive natural and social systems.”<sup>98</sup>

#### F. Integrative resilience

Analyzing resilience in finance therefore requires an agenda for defining systemic resilience at the outset, as well as an agenda for how characteristics of resilience can be fostered through legal and governance processes. This is a very tall order. At the level of the law, for example, financial regulation interacts with a range of other legal provisions such as property rights, contract law, corporate law, and international investment law, as well as with the political, institutional, and power structures of a given country. It also suffers from the fact that the organizational bureaucracies put in place to implement financial regulation can themselves become rigid and resistant to change over time, and subject to their own particular dynamics.

The behavior of agents in various interacting processes and systems is then another essential component affecting the dynamics of the system and its ability to cope with shocks. Ecology theory quickly realized that the resilience of an ecological system could only be meaningfully understood and defined through reference to the interplay of ecological and human/social systems. The influence of human agency on an environment is so great that the ecology cannot be analyzed in isolation. Both systems were symbiotically undergoing dynamic changes, and resilience therefore embodies the notion of constant change of symbiotically mutating systems that nonetheless generate stability. The resilience of one system therefore draws upon the

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<sup>97</sup> K. DOWD & M. HUTCHINSON, *ALCHEMISTS OF LOSS: HOW MODERN FINANCE AND GOVERNMENT INTERVENTION CRASHED THE FINANCIAL SYSTEM* 290 (2010).

<sup>98</sup> J. B. Ruhl, *Panarchy and the Law*, 17(3) *ECOLOGY SOC'Y* 31, 32 (2012).

resilience of other systems with which it is nested or interdependent. Could this mean that resilience in finance requires a far greater capacity to capture and respond to feedbacks from social, economic, political, and institutional dynamics than is currently the case? Such dynamics express the tapestry of power-relations in different societies and how this can affect financial system functioning. Due to the fragmentation of institutional, legal, and disciplinary boundaries, they are currently largely isolated from each other as areas for policy debate. Analyses of financial sector governance will typically ignore issues of political organizational development, local poverty and economic inequality, and ethical issues, but once resilience is defined from a broader frame of reference than simply the business continuity of financial institutions, they all become part of an agenda for resilience, particularly in a globalized world.

A further relevant question, then, is the scale of observation from which we observe resilience of the financial sector. Is it purely a question of business continuity and viability under stress of financial market participants as regulation is currently drafted? Or in this globalized world is it also a question of the impact of dynamic financial processes on a whole range of other systems—ecological, political, and social, for example—which in turn shape the resilience and continuity of financial markets? Expanding inquiry to this scale to take into account interlocking dynamics of various systems will invariably raise normative questions of the functions of finance and the impact of its dynamics on local processes. If trading commodity derivatives generates profits for firms in New York, London, and Switzerland, but impacts livelihoods in Sub-Saharan Africa which in turn affects the resilience of their social and political structures, is this a question for the resilience of the financial architecture? If markets aren't efficient allocators of capital, then what is their purpose and what should the resilience agenda aim to protect? Ultimately, a fundamental question that needs to be asked at the outset is: resilience of what and for whom?

## V. AN AGENDA FOR FINANCIAL RESILIENCE

Although this paper has merely skimmed the surface of what is a complex and ever-expanding debate in order to highlight some themes, we can now contrast eight different characteristics of a resilient system as defined in ecology with features of the modern financial system. The characteristics of a resilient system in a SES sense are:

- Capacity to reorganize and persist in response to shocks,
- Panarchy,
- Hysteresis,
- Adaptive governance and management processes,

- Dynamic interplay of resilience at different temporal and spatial scales,
- Interlocking, nested complex adaptive systems,
- Incalculable dynamic uncertainty, and
- Heterogeneity.

In contrast, the features that characterize the current approach to conceptualizing and regulating the financial system are:

- Robustness/stability,
- Frictionless equilibrium,
- Static governance around a perceived single equilibrium,
- Isolation of financial system stability as the single purpose of regulation,
- Financial system stability assessed from the perspective of market dynamics, with impacts of the financial system on other systems largely ignored,
- A calculable distribution of risk, only intermittently disrupted by tail risk events, and
- Homogenization of system participants fostered by regulation, benchmarking and herding, heightening correlation in times of stress.

These lists indicate a need to rethink our understanding of the nature of the financial system and its resilience, including what is meant by resilience in finance. Applying the notion of resilience as it has come to be understood in social-ecological systems science raises some fundamental questions about the prevailing architecture of financial theory, of financial regulation, of the management and governance of the system, as well as normative questions about the purpose of the financial markets and their impacts on other systems. A broader systems perspective on the interaction of finance with other interdependent systems raises the question whether we need in fact to rethink its boundaries as part of a study of the nature of financial resilience. If global financial markets are causing acute stress in the cost of living and destabilizing political regimes that in turn impact financial markets, should this be part of a broader debate on financial resilience even if it does not immediately impact the viability of financial institutions? How wide do we cast the net of resilience? The deepening of global financial markets has resulted in the growing interdependence of systems and an ever-expanding influence of financial markets on other features of daily life. These can in turn symbiotically influence the performance of financial markets and cannot be excluded from a resilience framework.

Once we have defined resilience, how then do we manage for it? The postcrisis regulatory architecture builds largely on the pre-existing



architecture rather than on radical rethinking.<sup>99</sup> It aims to bolster the stability of key hubs of the system such as systemically important banks and insurers, or through central clearing for over-the-counter derivatives, or otherwise by addressing specific issues that were critical to the last crisis. This in no way guarantees systemic resilience going forward as the epidemiology of each crisis is unique, and this approach may, in the long run, exacerbate fragility.<sup>100</sup>

It has become clear in ecology that designing a management system around a particular web of ecosystem diversity implies effectively imposing value judgements on the system as to which characteristics we wish to protect and help endure. The choice of management methodology in itself then affects the dynamics of the system. In application to finance, this raises theoretical questions around what we are managing resilience for, which strays into normative territory. Currently, the regulatory debate assumes that the current “efficient” financial system is the optimal one only if we can fix the failings that led to the last crisis—and hence we have an incremental approach to postcrisis regulation. But this approach is effectively loaded with a qualitative judgement on what functions the financial system is meant to serve and which features are optimal from a particular worldview. When deconstructed in light of alternative equilibrium states of the system, this is fraught with value judgements that only take into account a limited range of socio-economic impacts, and which prioritize maintaining the status quo for financial entities as the optimal outcome of a regulatory regime. A broader analysis of resilience dynamics requires that this normative judgement be placed at the forefront of redesigning an architecture of financial resilience.

## VI. CONCLUSION

Resilience is a fashionable concept that is currently being applied in a variety of disciplines, and which has frequently been used in debates on financial regulatory reform since the crisis. Current use of the term *resilience* in regulatory pronouncements appears to be based on an assumption that resilience is another word for financial stability, and that postcrisis changes which improve the current framework to address the specific failings that led to the latest crisis are sufficient to build resilient financial markets. However, *resilience* is a much deeper and more complex concept than this, and work in social-ecological systems science has identified key features of resilience

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<sup>99</sup> Ross. P. Buckley, *The Changing Nature of Banking and Why It Matters*, in RECONCEPTUALISING GLOBAL FINANCE AND ITS REGULATION (R. P. Buckley, E. Avgouleas & D. Arner eds., 2016).

<sup>100</sup> Folke et al., *supra* note 41, at 4 (“there is a danger in becoming too focused on specified resilience because increasing resilience of particular parts of a system to specific disturbances may cause the system to lose resilience in other ways.”).

in complex adaptive systems that allow systems to persist and renew in the face of disturbance. Applying those features to the characteristics of the contemporary financial system and the regulatory agenda indicates that there is a need for a much more comprehensive debate on what we mean by a resilient financial system, and who or what should be resilient.

Most often today, when financial regulatory agencies speak of resilience, they mean *robustness*, and it is not clear that anyone really knows what a truly resilient global financial system would look like. It is usually taken as a given today that the objective of regulation is the viability and business continuity of financial entities, but this presupposes key aspects of resilience which do not necessarily hold true in complex, dynamic, nonlinear systems. Building resilience in the global financial architecture may require a broader perspective that builds upon notions of multiple equilibria, incalculable uncertainty, the dynamic heterogeneity of system participants, and the importance of the interaction of resilience in multiple interacting systems for the resilience of the financial system. Drawing on resilience as it is defined in ecology would therefore require a cognitive shift in perceptions of resilience in the financial markets towards a more dynamic, multivariate concept of the system which in turn calls for a re-envisioning of the system and its governance.